INTRODUCTION TO ENERGY EFFICIENCY IN CATERING ESTABLISHMENTS

BEST PRACTICE PROGRAMME

Energy Efficiency Office
DEPARTMENT OF THE ENVIRONMENT

CONTENTS

1

INTRODUCTION

1.1 Who this guide is intended for

This guide is aimed at those responsible for energy in restaurants, public houses, workplace canteens and kitchens. In smaller organisations this may be the property manager and in larger organisations the corporate energy manager. The guide may also be of use to managers of other businesses involving catering, such as in workplace canteens and restaurants and to managers of individual restaurants or public houses. It can also form the basis of material to be distributed to restaurant managers and public house landlords.

It is intended to introduce the steps that anyone responsible for energy needs to take in order to control and reduce energy consumption. It shows how to gain an understanding of energy use in catering and indicates the methods by which savings are likely to be made.

1.2 Use of the guide

This guide is one of a series for different types of building. A full list of titles is given in section 9.4; make sure that you have the guide most suited to your needs. This guide is not aimed at inns and public houses which provide residential accommodation; these are covered by the guide on hotels.

If you are unfamiliar with energy management, you should start with section 2, Energy Management, in order to get an overview of the subject.

- The subsequent sections concern creating and following an action plan (section 3) and implementing measures to achieve energy savings (section 4). Sections 5 to 7 describe methods for assessing energy use in your estate or building.
- The case studies (section 8) give examples of restaurants and pubs where energy saving measures have been successfully implemented.
- Section 9 lists further sources of help and information, including addresses for obtaining copies of the information referred to throughout the guide.

More experienced energy managers or consultants may use the action plan (section 3), or the suggested measures (section 4) as aide-memoires. They may also use the method for calculating performance indices described in section 6 and appendix 1.

1.3 Environmental benefits of energy efficiency

Most of the energy used today originates from fossil fuels (gas, oil and coal). Burning fossil fuels emits pollutants, including gases that cause acid rain, and carbon dioxide. As carbon dioxide and other gases build up in the atmosphere, more of the sun's heat is trapped (the greenhouse effect). This could result in the earth becoming hotter (global warming), which may also increase the risk of storms, coastal flooding and drought. Using energy more efficiently is one of the most cost effective means of reducing emissions of carbon dioxide and also helps to conserve finite reserves of fossil fuels.

1.4 Financial benefits of energy efficiency

Energy is a substantial, but controllable cost in running catering establishments. Using simple and cost effective measures, fuel bills can often be reduced by about 20%. Further savings are possible in new construction and when buildings are refurbished or their services replaced. Worthwhile energy savings can be realised from improving catering efficiency even if kitchens or canteens form only a part of your buildings.

Well designed and efficiently managed services not only result in energy savings, but also in an improved and more comfortable environment for customers and staff. They also contribute to a better level of service.

In addition, efficiently run buildings require less manpower to service complaints, providing savings additional to the reduced costs of energy.

1.5 Acknowledgements

This guide was prepared for the Energy Efficiency Office (EEO) by Target Energy Services Ltd. The EEO gratefully acknowledges the assistance given by the following organisations in providing information:

Building Energy Solutions

Greene King plc

McDonalds

Nationwide Building Society

Sutcliffe Catering Group Ltd

Whitbread plc

Royal College of Surgeons

ENERGY MANAGEMENT

2.1 Energy efficiency - a management issue

The aim of energy management is to ensure that energy use and energy costs are as low as possible while standards of comfort, service and productivity are maintained or improved. This requires somebody to be directly responsible for energy efficiency, even if this is only a part of their job:

- As a rule of thumb, organisations or sites with an energy bill over £1 million may justify the employment of a full time energy manager. Otherwise, energy management will normally be combined with other responsibilities.
- In organisations with an estate of buildings, energy efficiency should be managed centrally.
- Each building should also have someone responsible for energy management.
- Energy efficiency must be strongly supported at the highest levels with the authority and resources needed for initiatives to be effective.

Encourage your management board to sign up to the EEO's Making a Corporate Commitment campaign if it has not already done so (see section 9.5).

The duties and functions of an energy manager responsible for an estate of buildings are outlined in this section. Section 3 includes a suggested action plan which can be used to get things moving.

For further information see:

EEO General Information Report 12 - Organisational aspects of energy management
EEO General Information Report 13 - Reviewing energy management
Making a Corporate Commitment - various guides

2.2 Controlling energy use

To control energy consumption and costs, regular and reliable records of energy use should be maintained. Such records will help to identify changes in energy costs and consumption. This is commonly called monitoring and targeting or M&T. The simplest arrangement is a form which can be filled in regularly for each fuel, recording monthly energy use. Alternatively, systems can be based on a computer spreadsheet, or commercially available software systems can be purchased. Computer based systems are essential for effective monitoring of a large estate.

An M&T system should:

- Record energy consumption and any other factors that affect energy use (building usage, weather, turnover, etc).
- Compare a building's energy use to previous years, to other buildings in the estate, or to yardsticks representing typical or target energy performance.
- Alert you to sudden changes in energy use patterns as soon as possible, so that any increase can be investigated and corrected if appropriate.
- Produce regular summary reports, especially if there are many sites, to confirm performance and show savings achieved overall.

If fuel bills are not available or some are missing, then duplicates can usually be obtained on request from the relevant fuel supply company. Meters should be checked every few months to ensure that billed readings are correct. In shared or multi-meter sites ensure you are being billed for your use; label your meters.

In larger catering establishments, consider sub-metering major loads such as gas for cooking and electricity for refrigeration, in order to target areas for action.

Organisations which employ contract caterers should ensure that the caterer has responsibility for the energy used. The energy used for catering should be metered separately and the caterer charged for it. The contract should also specify energy targets.

Example recording of monthly electricity use

Period: *JAN-DEC 92* Completed by: *NJK* Date: *10.2.93*

Meter Reading Date	kWh Used	Cost £
8.1.92	*39,700*	*2756.29*
5.2.92	*38,700*	*2653.65*
5.3.92	*31,500*	*2200.35*
9.4.92	*25,000*	*1584.02*

2.3 Getting on the right tariffs

Making sure that fossil fuels and electricity are purchased at the cheapest rates is increasingly important. Considerable cost savings are sometimes possible by changing to more suitable tariffs for electricity, or by making alternative supply arrangements.

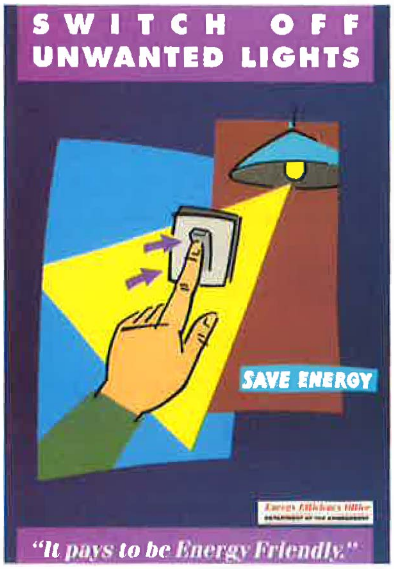
It may also be possible to reduce energy costs by negotiating single purchase agreements for all the buildings in an estate.

Tariff savings usually incur little or no initial cost and may be used to help finance measures to reduce energy costs further. Reviewing tariffs should therefore be one of your first actions:

- Seek alternative electricity tariffs from your existing supplier.
- Check that the supply capacity for electricity at each site (the agreed maximum available supply charged as shown on your electricity bill) is not excessive compared to the existing or expected maximum demand.
- Consider using other electricity suppliers in the contract market when the supply is for more than 100 kW (representing a bill of around £30,000 a year).
- Consider a different supplier for oil, or for gas supplies over 70,000 kWh a year (representing a bill of around £1,000 a year).
- For large sites with complicated tariffs and load patterns, it may be worth employing a tariff consultant, although be aware of consultants' costs (contact the Energy Systems Trade Association (ESTA) or the Major Energy Users' Council, see section 9.9).

For further information see:

EEO Fuel Efficiency Booklet 9 - Economic use of electricity in buildings.



Energy Efficiency Poster

2.4 Actions and measures to save energy

One of your main activities should be to identify areas of energy waste and implement energy saving measures to reduce them. Some waste is simple to diagnose and to correct, for example unnecessary lighting left on all night. Other waste may be more difficult to identify and take more expertise or resources to correct (see section 4).

If you are a central energy manager, you will be responsible for many separate locations. For large estates, savings can be maximised by employing energy saving measures and initiatives which can be widely applied across the majority of premises. These measures should be easy to implement, manage and follow up.

A good working knowledge of the estate is required to identify these measures. This can be gained by:

- Visiting sites and then considering a programme of standard energy surveys
- Talking with restaurant staff
- Reviewing building services specifications
- Talking with refurbishment design staff, consultants and maintenance and other contractors.

Your first priority should be to establish a comprehensive and reliable M&T system and have good site information.

The most suitable restaurants or pubs for energy surveys can then be identified by producing a league table of performance indices (see section 6) and starting with the worst performers.

For more complex measures, conduct trials at selected sites to establish payback periods and installation and operating parameters, such as the best location for equipment and the optimum control settings.

2.5 Interaction with other groups in the organisation

Guidelines showing the cost and environmental benefits of energy conservation together with a package of information explaining simple energy saving measures should be disseminated to each restaurant or pub. In large organisations it will be impracticable for the Energy Manager to liaise directly with each site, and the existing management structure should be utilised. For example:
Energy Manager → Area Manager → Restaurant Manager → Head Chef and restaurant staff.

In organisations with smaller estates, you may find it possible to deal directly with each site.

You should ensure that someone is responsible for energy management in each building, even if it is only a small part of their job. Ideally this will be the Restaurant or Pub Manager, who should be provided with training through seminars and literature. Literature might include checklists such as the one in section 4.1. Managers' responsibilities would include:

- Briefing all restaurant staff on how to operate controls
- Undertaking walk arounds to identify avoidable waste
- Acting as an interface between restaurant staff and the central energy manager for comments reflecting dissatisfaction and suggestions for energy saving measures.

2.6 Motivating staff

The greatest possible savings can only be achieved with the cooperation of staff. Foster their support and give staff every chance to participate in energy saving initiatives. Feed back information to staff on the results of these initiatives.

The primary motivation for Area and Restaurant or Pub Managers will be the financial benefits to area or restaurant/pub operating performance. Set targets and produce league tables of performance trends within an area to provide an additional incentive to Restaurant Managers through peer competition. Restaurant staff may be motivated more by the environmental benefits and the improved levels of comfort. In companies which have a canteen the motivation should come as part of the company's corporate commitment to energy efficiency.

Awareness and motivation can be further raised by energy and environmental messages from senior management using staff magazines and videos and by the production of company posters, stickers and leaflets.

You should monitor the savings achieved and publicise them to help motivate staff and senior management. Obtaining capital investment for future energy efficiency measures may depend on demonstrating the cost effectiveness and the environmental benefits of measures that have already been completed.

For further information see:

EEO Good Practice Guide 84 - Managing and motivating staff to save energy.

2.7 New buildings and equipment

Energy efficiency measures are most cost effective when installed in new or refurbished buildings, or while replacing or improving equipment. These special opportunities to incorporate energy efficiency measures are relatively rare and should not be missed.

You should be involved in decisions about new or refurbished property and the selection of new equipment, and should not just be brought in to correct high energy use following decisions made by others. Your knowledge of how the buildings in your estate are used and the level of catering provided in your kitchen should be drawn on when specifying appropriate levels of equipment, services and controls.

When moving or refurbishing premises, take the opportunity to select or specify:

- Energy targets
- The type of accommodation - for example, the inclusion of full or partial air conditioning may double overall energy costs
- Systems which are suitably simple and within the capabilities of the occupants to manage
- Fossil fuel rather than electric heating where possible
- High efficiency of major plant such as boilers
- Good levels of insulation
- Appropriate controls for the anticipated pattern of use
- Suitable metering and monitoring facilities
- Information, advice and training for staff in the use of new systems.
- Sufficient space to install low energy equipment

and in kitchens, specify:

- Gas for cooking where possible
- Energy efficient appliances
- Provision of space heating, independent of the cooking facilities, with local control so that cooking equipment does not have to be used for heating.

For further information see:

EEO Good Practice Guide 71 - Selecting air conditioning systems.

Refurbishment offers a rare opportunity to incorporate many energy efficiency measures.

2.8 Getting help

Sources of further information are described and listed in section 9.

To obtain further information about possible energy saving measures (see section 4), contact relevant manufacturers, installers or service providers who will advise you of the features of their products. Make sure that these features are relevant and appropriate to your requirements. Gas and electricity suppliers can also offer advice.

If time is not available or if discussions with a selection of competing suppliers do not provide a consistent picture, it may be worth hiring a professional consultant to provide advice or to conduct energy surveys. For organisations with less than 500 employees the EEO's Energy Management Assistance Scheme (EMAS) may offer financial help towards energy consultants' fees (see section 9.5).

If the availability of finance and management time is a problem for opportunities requiring substantial investment, contract energy management (CEM) organisations may provide a solution - they offer a comprehensive service including finance and management responsibility. ESTA can provide a list of companies (see section 9.9).

For further information see:

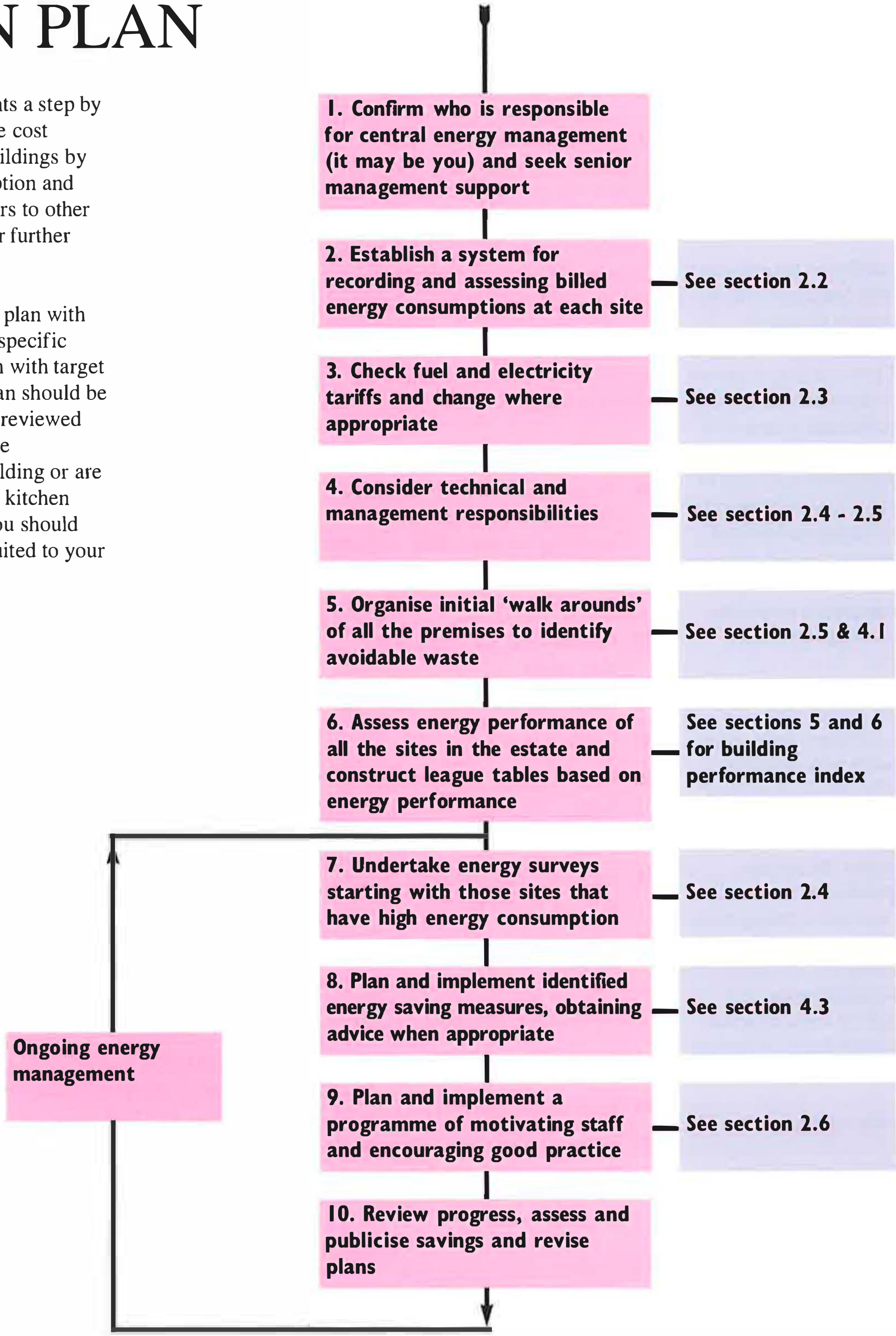
Choosing an Energy Efficiency Consultant (EEO).

3

ACTION PLAN

This flow diagram presents a step by step procedure to achieve cost savings in an estate of buildings by bringing energy consumption and cost under control. It refers to other parts of this document for further guidance.

Produce your own action plan with these headings, showing specific actions and projects, each with target completion dates. The plan should be consulted frequently and reviewed annually. If you only have responsibility for one building or are responsible solely for the kitchen area within a building, you should draw up an action plan suited to your own requirements.



4

MEASURES TO ACHIEVE ENERGY SAVINGS

4.1 Initial measures

In most restaurants and pubs it is possible to make some savings by using the existing building and equipment as efficiently as possible. No financial investment is needed; instead, a check on how the building and catering equipment are being used may reveal areas where equipment can be turned off when it is not needed, or where usage can be reduced without affecting the level of service to customers.

Some opportunities may be easy to identify and implement, such as altering thermostats or timeclocks. Others, such as turning lights off when rooms are not being used, may require the cooperation of staff. Motivating staff to help is therefore important, although a long term task. The list below indicates the type of items to check in an initial assessment of 'good housekeeping' opportunities. An exercise to review energy purchasing tariffs (see section 2.3) should be carried out at the same time.

Checklist of Initial Energy Saving Measures

Kitchen equipment

- Run dishwashers on full loads only.
- Consider using sanitising liquids and water softeners to reduce boost temperatures.
- Ensure taps are not left running when not needed.
- Inform kitchen staff of heat-up times for cooking equipment - less than ten minutes for many hobs, grills and convection ovens, 15-20 minutes for heavier equipment; discourage staff from using hobs or ovens for space heating.
- Encourage kitchen staff to assess how much equipment is needed at different times of the day, and to switch off equipment when it is not needed; for example, do not leave hobs burning when not in use.
- Use pans that have the proper base size for hobs.
- Keep lids on pans.
- When pans come to the boil turn hobs down to the minimum needed to simmer, as more vigorous boiling will not cook the food any more quickly.
- Minimise hot storage of cooked food.
- Use a microwave oven rather than the main ovens to reheat small quantities of food.
- Ensure hot cupboards are well insulated and fitted with thermostats.
- Use a toaster to toast small quantities of bread (rather than a grill).
- Locate refrigerators and freezers away from sources of heat.
- Minimise the frequency of opening refrigerators and freezers and ensure that they are not left open unnecessarily.
- Avoid putting hot food in refrigerators.
- Ensure the doors to walk in freezer store rooms are not opened unnecessarily and are not wedged open during restocking periods.

Space and water heating

- Ensure taps are switched off after use and leaks are attended to.
- Consider fuel switching (if your boiler(s) can operate using more than one fuel).
- Check that time switches are set to the minimum period and ensure that room thermostats and radiator controls are on minimum settings commensurate with comfort conditions.
- Ensure that only occupied areas are heated, and that heating is off or reduced when not in use.
- If you have a building energy management system (BEMS), check that it is operating correctly and ensure that operators are trained to use it effectively.
- Reduce temperature of stored domestic hot water by turning down the thermostat to a minimum of 60°C, but no lower because of the risk of Legionella.
- Make sure that pumps are running only when required.

Lighting

- Ensure that someone is responsible for switching off lights in each room or area when not in use. Label or colour code light switches to assist this.
- Make the best use of daylight by keeping windows and roof lights clean and, when daylight is good, restricting artificial lighting to that necessary for ambience.
- Turn off lighting in customer areas outside opening hours where possible and turn off lighting in the cellar when it is not being used.

Ventilation

- Ensure the main ventilation plant and toilet extractor fans are switched off outside occupancy hours. If possible, switch off the plant that serves customer areas outside opening hours.
- Check that windows are not being opened to avoid overheating during winter.
- Ensure kitchen fans are switched off when no cooking is taking place.

Air conditioning

- Set room controls for cooling to 24°C or higher - lower settings require more cooling energy and may be 'fighting' the heating.
- Where the design permits, ensure heating and cooling are not on at the same time in the same part of the building (the advice of a consultant or on site services engineer may be needed).
- Make sure that refrigeration plant such as chilled water systems do not run unnecessarily.
- Ensure that fans and pumps do not run when not required.

Controls

- Ensure all controls are labelled to indicate their function and, if appropriate, their new reduced settings.
- Establish responsibilities for control setting, review and adjustment.

Cellar cooling

- Ensure that cellar thermostats are not set lower than necessary for the product stored.
- When the cellar is not being used, ensure the door is kept closed.
- Ensure the airflow to the external heat exchanger is adequately ventilated and the condenser fins are kept clean and free of leaves and rubbish.
- Ensure that equipment which emits heat, such as machines and freezers, is not kept in the cooled cellar.
- If direct heating of the cellar is required in very cold weather, ensure the heater is properly controlled so as not to fight the cellar cooling, or switch the heating off until needed.

Building fabric

- Ensure all insulation is in a state of good repair.

4.2 Maintenance

Regular maintenance is a prerequisite to controlling energy costs and is also essential for maintaining a healthy environment in buildings.

Maintenance contractors can be a useful source of information about buildings and services. If suitably qualified, they can also be used cost effectively to undertake brief energy surveys and to install simple energy saving measures, such as timers and insulation.

A maintenance programme should include:

- Replace filters at the manufacturer's recommended intervals and keep heat exchanger surfaces, grilles and vents clean in order to allow unobstructed flow of air
- Ensure that the extractor hood grease filters in the kitchen are cleaned regularly
- Check plant operation and controls regularly
- Check time and temperature settings of electric panel and storage heaters
- Ensure that all motorised valves and dampers fully open and close without sticking
- Check that thermostats and humidistats are accurate
- Check calibration of controls
- Service the boiler plant and check combustion efficiency regularly
- Look for water leaks and carry out repairs where necessary
- Clean windows to maximise daylighting
- Replace 38mm diameter fluorescent tubes in switch start fittings with 26mm diameter high efficiency triphosphor tubes as the former expire
- Clean lamps and luminaires regularly and replace at the manufacturer's recommended intervals
- Check refrigerant levels
- Clean and straighten cellar cooling evaporator and condenser fins
- Check condition of fridge/freezer door seals
- Ensure fridges and freezers are properly defrosted.

4.3 Longer term measures

There will almost certainly be items of equipment or insulation which could be replaced with more efficient alternatives. The main areas for savings, starting with the most cost effective, are:

- Control systems
- Lighting
- Catering equipment and appliances
- Heating and air conditioning plant
- Building fabric.

Care is required in deciding which measures to implement and the most effective way of carrying them through. In the first instance, measures should be undertaken which have as many of the following features as possible:

- Worthwhile energy and cost savings
- Low capital cost
- Short period to repay initial cost
- Widely applicable across the estate
- Little technical knowledge required
- Little or no extra maintenance
- Little or no disruption to normal operations.

Further information is given in references listed in section 9 - note particularly:

EEO Fuel Efficiency Booklets:
1 Energy audits for buildings
8 The economic thickness of insulation for hot pipes
10 Controls
12 Lighting

EEO Good Practice Guides:
15 Energy efficient refurbishment of public houses

Energy Efficient Lighting in Buildings. A THERMIE Maxibrochure.

Assessing costs of measures

The cost effectiveness of an energy efficiency investment can be expressed as the initial cost divided by the monthly or annual cost savings - the simple payback period.

More sophisticated appraisal techniques for comparing different investments, such as 'discounted cash flow' methods, are sometimes used in larger organisations and for major investments. If these are needed, advice should be sought from those who use these methods.

If energy-saving initiatives are taken during refurbishment or when moving, capital cost is often substantially reduced and interference with normal working practices is kept to a minimum.

For measures included during replacement or refurbishment, the initial cost (for calculating the payback period) is only the over-cost: for example, the extra cost of a high efficiency 'condensing' boiler compared with a conventional boiler. This reduces payback periods and increases cost-effectiveness.

In some cases, energy efficiency measures can reduce overall capital costs, such as using natural ventilation which avoids the need for air conditioning.

Where shortage of funds and/or lack of expertise is holding up promising measures, it may be worth considering contract energy management as described in section 2.8.

Measures can be split into those which require limited attention such as insulation, and those which require management time to ensure that they continue to be effective, such as building energy management systems. For the latter, manageability is as important as the potential for energy savings, and should be a prime consideration in the design.

CATERING EQUIPMENT

The energy cost of running conventional electrical catering equipment for cooking is considerably more than that of running gas equipment. If a site has a gas supply it is therefore preferable in energy terms to use gas for

cooking rather than electricity. There is a wide range of catering equipment and appliances designed for a range of different needs. Manufacturers are beginning to provide options that are more energy efficient. Although often more costly, these options should be seriously considered for the benefits in operating costs over their life in service. Options to consider are:

- Microwave ovens heat food directly and are off when not in use - they are therefore highly efficient for smaller quantities of food.
- Fan-assisted ovens - provide a more even distribution of heat which allows food to be cooked more quickly and means that shelves can be spaced more closely. They therefore consume less energy per kg of food cooked.
- The induction hob - an energy efficient alternative to the conventional electric hob, providing up to 50% energy savings, but does require special pans. Only the pan and its contents are heated, the hob itself remains relatively cool.
- Double-sided grill - heats food faster than deep fat frying or single-sided frying. Also produces less smoke than a conventional grill and reduces nutritional losses and excessive colour changes.
- Infra-red grill - reduces cooking and pre-heat periods compared to a conventional grill.
- Pressure cookers, steamers and fryers - not only are they energy efficient, but this type of cooking also preserves and retains the food's dimensions, flavour, colour and nutrients better than conventional cooking techniques.
- Combination ovens with steam or microwave heating as well as conventional or fan assisted heating can provide highly efficient cooking but proper training of staff is required.

Ideally food should be served as soon as it is cooked. Where this is not practicable food should be kept at optimum temperatures for the shortest period of time.

Catering equipment measures

- Compare power ratings and energy consumptions while in use of different equipment and appliances before selecting, especially where equipment is being specified across all or part of an estate.
- Use double-sided grilling and frying equipment, infra-red grills, fan-assisted ovens, deep fat fryers, pressure cookers and steamers wherever possible.
- Consider using induction hobs as an alternative to conventional electric hobs.
- Consider using double sided grills in preference to single sided frying or deep fat frying.
- Consult the supplier of your dishwasher and, if possible, provide a hot water feed in cases where the water is heated by a fossil fuel.
- Fit in-built piezo-electric spark generators to gas burners - gas burners are often left alight when not being used because of the inconvenience of finding a light during busy periods.
- Install two smaller items of equipment rather than one large one if demand is likely to be variable.
- Choose equipment with warning lights that indicate whether ovens are switched on or that the hob surfaces are hot, and with robust and easily operated door catches. Avoid appliances with unconventional controls, such as dials that move in opposite directions.
- Consider installing a heat recovery system to recover reject heat from refrigerator condensers.
- Install self closers on doors of ovens, fridges and freezers.
- Install motor optimiser controllers on refrigeration plant, but ensure that they are properly adjusted.
- Select:
  - low energy fridges and freezers
  - steamers and fryers with good temperature controls and a high degree of insulation
  - well insulated ovens and dishwashers
  - low water use dishwashers.

CELLAR COOLING

A large number of beer cellars are mechanically cooled to provide low temperature storage. The mechanical cooling systems comprise the cooling units inside the cellar and the external units which dissipate heat. The heat from the external unit can be recovered in some cases for useful heating or hot water.

Cellar cooling measures

- Ensure the cooling system is correctly sized for the load.
- Keep refrigerant pipe runs to a minimum, consistent with the above requirements.
- When selecting a mechanical cooling system consider a heat pump or heat recovery condenser unit, which allows the waste condenser heat to be used to preheat the domestic hot water.

HEATING

The cost of providing heat for space heating or hot water depends on the cost of the fuel used, the efficiency of conversion of fuel to heat, and the extent of the distribution losses in supplying the heat when and where it is needed.

Fossil fuels such as gas, oil or coal are usually burnt in a boiler and the heat is transferred to a heating system. Boilers have varying seasonal efficiencies - old boilers may convert less than 50% of the energy content of the fuel into heat in the heating system, while the most efficient gas condensing boilers may achieve seasonal efficiencies of over 90%.

Condensing boilers can be used with most existing heating systems and ought to be considered whenever boilers are replaced.

Heat is lost from the heating system through pipework, valves and hot water storage tanks. Pipe runs should be short, and all parts of the system well insulated. Heat should only be

supplied to a space or to produce hot water where and when it is needed. Where possible, large boilers should not be operated to meet small loads, as the efficiency will be very low.

Effective heating controls are essential. Types of control include:

- Simple time control: a time switch that turns heating on and off at a fixed time each day - seven day time switches allow for variable occupancy during the week.
- Optimum start control: switches the heating on so that the building reaches the desired temperature just in time for occupation.
- Weather compensation: varies the heating according to the outside temperature.
- Room thermostat: keeps the temperature in a room to a required level.
- Thermostatic radiator valves (TRVs): regulate the flow of hot water through the radiators in a room in order to maintain a local temperature.
- Boiler sequence control: enables only the number of boilers required to meet the system demand.
- Zone control: the building is split into zones with each zone controlled independently.

The 1990 Building Regulations specify that new non-domestic buildings should have time and temperature controls, and that large buildings should also have optimum start and boiler sequence controls.

Heating measures

- Separate the heating system into zones so that areas of the building with different heating requirements can be controlled separately.
- Fit TRVs in rooms with variable needs for heating such as bar areas.
- Upgrade heating controls to include a seven day programmable timer, optimum start control and weather compensation as a minimum.
- Where small volumes of domestic hot water are required a long way from the main heating plant, consider installing local instantaneous water heaters.
- Install spray taps where possible.
- Insulate hot water tanks and boilers, and all pipework, valves and flanges which do not provide useful heat to occupied spaces.
- Replace an old boiler installation with one that provides a minimum seasonal efficiency of at least 80%, preferably including at least one condensing boiler. Specify multiple boilers with a sequence controller rather than one large boiler in installations over 100kW, with the most efficient boiler leading the firing sequence.
- Ensure that boilers can only run when there is a heat demand. Unnecessary firing is known as "dry-cycling" and is often remedied by correctly wiring the boiler thermostat into the control system. In multi-boiler installations, wide band thermostats often overcome dry-cycling.
- Install a heater other than the main boiler to produce domestic and catering hot water, and turn off the main boiler during the summer.

LIGHTING

Good savings can be achieved by ensuring that the lighting equipment and its controls and management are of a high standard.

The energy used for lighting depends upon the energy consumption of the lamps and the hours of use. The most efficient systems are well designed, and have efficient lamps and fittings which provide the required level of illuminance (without over-lighting). They have controls which enable the lights to be switched off when they are not required, whether because a space is not being used or because there is sufficient daylight.

It should be noted that good lighting design involves much more than calculating the number of fittings required to give a certain light level and selecting light fittings that blend in with the overall image. In many cases, the use of a professional lighting consultant may prove beneficial in assessing the interaction between lamp type, fitting design, building design and the comfort of customers and staff.

Some types of lamps, in order of increasing efficiency, are:

- 'Domestic' tungsten bulbs - very inefficient; should usually be replaced
- Tungsten spotlights - used for display lighting; even the most efficient lamps are much less efficient than fluorescent lamps
- Compact fluorescent lamps - efficient replacements for tungsten bulbs, although not as efficient as modern tubular fluorescent lamps; an increasing range of compact fluorescent downlighters is available including some that are suitable for display lighting
- Fluorescent tubes - used in most kitchen areas
- Metal halide and sodium discharge lamps - these vary in efficiency depending on type (most are more efficient than fluorescent tubes). Sometimes used in uplighters; well suited to lighting large areas such as car parks.

Tungsten bulbs typically have a life of about 1,000 hours, while fluorescent and discharge lamps typically last for 8,000 hours or more. Removing tungsten bulbs therefore gives substantial savings in maintenance costs in addition to energy savings.

Typical levels of energy consumption of different types of lamp, expressed as a percentage relative to tungsten lamps, are given in figure 4.1.

These figures give an indication of the typical savings which may be made by replacing lamps with more efficient alternatives. For example, replacing an old inefficient tubular fluorescent system (1) with a modern efficient system (3) would reduce energy consumption by a factor of 13/18, a reduction of about 30%.

As well as lamps, light fittings (luminaires) contain a number of other elements, including:

Luminaires, left to right: recessed mirrored reflector with louvres, batten fittings, opal, and prismatic diffusers.

Photographs supplied by Philips and Fitzgerald.

- Diffusers or louvres - these are designed to give a good distribution of light without glare. Luminaires with prismatic and especially opal diffusers are less efficient than those with reflectors.
- Control gear - fluorescents and other discharge lamps need control gear to strike up and maintain light output. Old fluorescent luminaires have chokes and starters; modern electronic controls (ballasts) are more efficient.

Lighting controls should be used to ensure that, as far as possible, lights are off when they are not needed. Lighting controls include:

- Manual control - it should be possible to control all lights manually, whatever automatic controls are also used
- Time controls - allow any group of lights to be switched on or off automatically at set times of the day
- Presence detectors - automatically switch lights on when somebody enters a space, and off again after the space is vacated.
- Daylight detectors - allow groups of lights to be switched off or on according to the level of daylight. Some lights can also be dimmed as daylight levels alter.

Figure 4.1 Typical relative energy consumption

lamp type	typical energy consumption relative to tungsten bulbs for similar levels of lighting (%)
tungsten filament bulb	100
tungsten halogen spotlight	70
high pressure mercury (MBF)	22
compact fluorescent with electronic ballast	18
metal halide (MBI)	15
high pressure sodium	11
low pressure sodium	7
Fluorescent tubes:	
(1) choke & starter control gear with 38mm diameter tubes	18
(2) as 1), but 26mm diameter high efficiency triphosphor tubes	16.5
(3) as 2), but with electronic high frequency control gear	13

Lighting measures

- Replace tungsten lamps with compact fluorescent lamps or, better, with tubular fluorescent lamps.
- Replace tungsten spotlights with compact fluorescent lamps or low voltage tungsten halogen lamps. The choice of replacement lamp will depend on the application.
- Replace existing control gear in fluorescent fittings with electronic, high frequency ballasts.
- Replace diffusers in tubular fluorescent fittings with reflectors and reduce the number of tubes if possible.
- If light fittings are over 15 years old, replace with new efficient fittings and consider installing new lighting controls.
- Use metal halide or sodium discharge lamps for outside areas such as car parks.

Improve lighting controls, including:

- local manual switching, so that lights in public areas can be turned off outside opening hours and staff can control their local lighting in back of house areas
- time controls or daylight detection controls for external lighting
- presence detection controls for areas which are infrequently used, such as stores and cellars.

MECHANICAL VENTILATION AND AIR CONDITIONING

Mechanical ventilation provides air which is filtered and heated. Air conditioning additionally provides cooling and humidity control. Air conditioning can be a significant energy user, and improving its control and operation can result in substantial savings.

Cooling is usually provided by an electrically driven refrigeration plant. Cooling systems should be controlled and insulated in the same way as heating systems. The savings will be proportionally higher as cooling is considerably more expensive to produce than heat.

Pumps and fans consume a considerable amount of energy; in air conditioned buildings they can consume at least half and often more of the total energy used for air conditioning.

Mechanical ventilation and air conditioning measures

- Install variable speed drives on fans and pumps; these allow motor speeds to be controlled according to the demand instead of running at full power continuously.
- Ensure that controls are set or improved to avoid both heating and cooling air at the same time.
- Ensure that air conditioning systems make use of outside air for 'free cooling' whenever possible.
- When heating or mechanical cooling is required, ensure that the proportion of air recirculated within the building is as high as possible within the requirements for minimum fresh air rates.
- Provide ventilation which supplies fresh air and extracts stale air directly above cookers to avoid needing high ventilation rates throughout the whole kitchen.
- If humidifiers are being specified or replaced use ultrasonic humidification (but ensure that precautions are taken to avoid Legionella).
- Explore the opportunities for heat recovery from any source of warm exhaust air but bear in mind the increase in pump and fan power that will be required.
- In public houses consider installing electrostatic air filters to clean and recycle air within public areas. This avoids wasting energy through introducing large volumes of cold air and extracting warm air as is the case with conventional extract fans.
- If there is an open fire or coal effect fire, ensure that it is provided with a separate ducted air supply from outside to minimise heat lost up the chimney.

BUILDING FABRIC

Most building fabric measures except simple roof insulation and draught proofing are most cost effective when they form part of general maintenance or refurbishment.

Caution: Insulation measures should be checked for condensation and water penetration risks.

Building fabric measures

- Insulate roof voids and flat roofs.
- Draught proof around windows and doors.
- Fit secondary glazing.
- Install cavity wall insulation or internal or external insulation.
- Reduce excessive glazing areas by replacing the glass with insulated wall panels.
- If windows are being replaced, fit multiple glazing, preferably with low emissivity glass which reduces heat loss in winter.
- Provide window blinds to minimise summer solar heating.
- Fit heavy curtains.
- Fit door closers.
- Install draught lobbies.

BUILDING ENERGY MANAGEMENT SYSTEMS (BEMS)

BEMS are computer-based systems which automatically monitor and control a range of building services such as heating, air conditioning, ventilation and sometimes lighting. They may also provide data on energy performance to enable energy savings to be targeted. They are most cost-effective in large buildings with complex building services.

Caution: A BEMS should be considered as an aid to management and not a substitute for it, and it is important that someone manages it to ensure that it operates effectively.

5

ENERGY USE IN CATERING ESTABLISHMENTS

5.1 Why analyse building energy use?

Assessing the energy performance of a building allows you to:

1. Compare performance with standards to suggest the potential for energy saving in the building.
2. Compare with other buildings in an estate or group of buildings to help identify which should be investigated first.
3. Compare with performance in previous years to monitor progress and to assess the effect of any changes or energy saving measures.
4. Consider the energy use in more depth to help understand where energy is used and wasted, and hence where savings are most likely to be made.

A general understanding of what electricity and fuels are used for helps to concentrate attention on priority areas, especially where the use of one of the fuels is particularly high.

5.2 Types of building and their energy use patterns

Energy consumption data are presented in this guide for the following building types:

- **Restaurant with bar**
- **Fast food restaurant**
- **Pub restaurant**
- **Public house**

Energy consumption data for restaurants and canteens within other buildings can be found (where the data exist) in other guides in this series (see section 9.4).

Each of the categories is described below.

Restaurant with bar
Figure 5.1 shows the typical energy cost breakdown for a restaurant with bar. The bar area would normally be small compared to the restaurant area, and the bar and restaurant would not usually be segregated.

Fast food restaurants
These are establishments providing meals/snacks of a specific nature (e.g. burgers, pizzas) generally with rapid service and making use of batch cooking. Food is provided for consumption on the premises or on a take-away basis and there is often limited seating accommodation. Figure 5.2 shows the typical energy cost breakdown for a fast food restaurant.

Pub restaurant
Figure 5.3 shows the typical energy cost breakdown for a pub restaurant. This is a pub which has a separate restaurant - the bar area would normally be comparable in size to and segregated from the restaurant area. There would be a beer cellar.

Public house
Figure 5.4 shows the typical energy cost breakdown for a public house. A snack bar service is often offered. Public houses usually include accommodation for the manager and sometimes staff - this would normally constitute about 5% of the energy cost.

The consumptions of energy for different purposes in any one building may be significantly different from the typical breakdowns given in figures 5.1 to 5.4.

Figure 5.1 Typical energy cost breakdown for a restaurant with bar

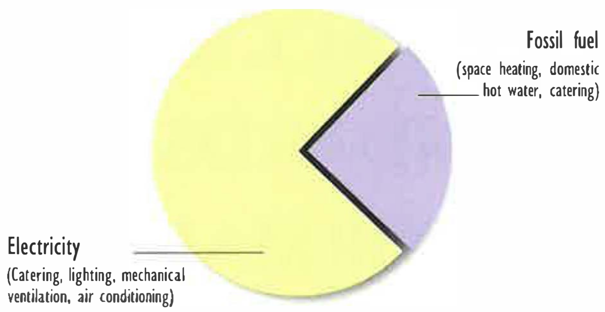


Figure 5.2 Typical energy cost breakdown for a fast food restaurant

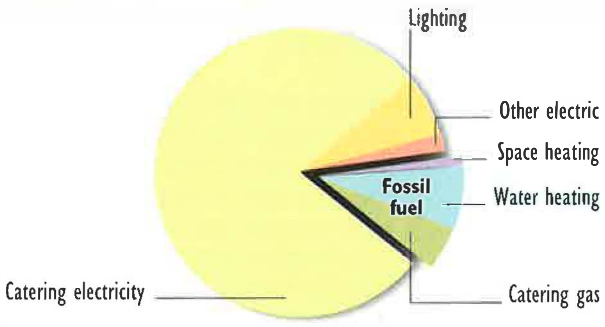


Figure 5.3 Typical energy cost breakdown for a pub restaurant

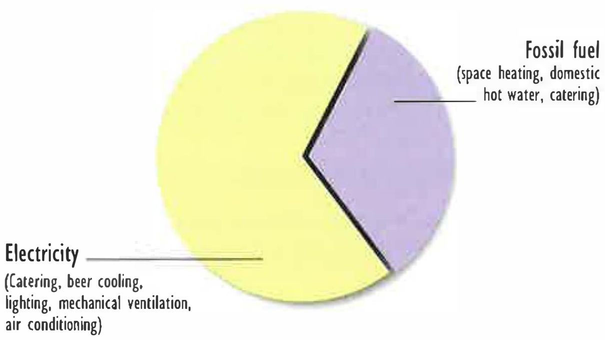
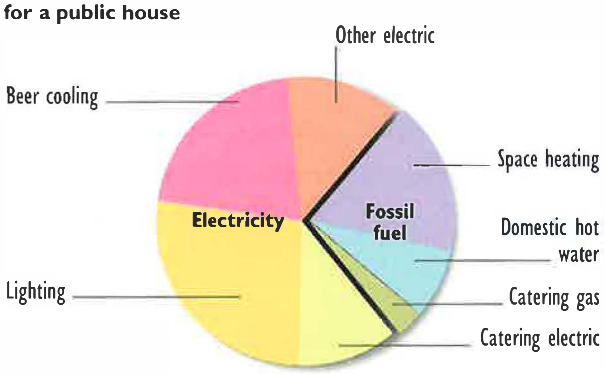


Figure 5.4 Typical energy cost breakdown for a public house



6

COMPARING WITH ACCEPTED STANDARDS - PERFORMANCE INDICES

6.1 Why use performance indices?

Performance indices give a measure of the energy use of a building which can be compared with the yardsticks. They can indicate the potential for improvements and can be used to show progress over time. They can also allow comparisons to be made between buildings in a group or estate.

Annual energy consumption of your building.

This is most conveniently obtained from past bills but take care that the figures collected represent a full year and are not "estimated" by the utility. It may be helpful to look at more than one year's bills providing that there have been no significant changes to the building or its use in that time. The numbers you require are the energy units consumed, not the money value. Include all fuels: solid fuel, bottled fuel, natural gas, oil and electricity.

Floor area and number of covers.

Gross floor area: Total building area measured inside external walls.
Number of covers: The number of place settings in the restaurant.

6.2 Calculating the performance indices of a building and comparing to yardsticks

Two separate indices are calculated for the building, one for electricity and the other for fossil fuels. The separate indices should not be added together, because of the different cost and environmental impact of fossil fuels and electricity.

The performance indices are obtained by dividing the annual building energy use by a measure of the building's size or turnover. Depending on the type of building, yardsticks are given based on the floor area of the building, the number of covers or the floor area and the turnover.

Restaurant with bar, fast food restaurant, pub restaurant

The procedure is:

1. Enter the annual energy use for each fuel into column 1 of figure 6.1.
2. Multiply each fuel by the conversion factor in column 2 to get common units of energy (kWh is used for electricity and now for gas - conversion units are given in Appendix 2).
3. For restaurants with bar and fast food restaurants enter the gross floor area of the building into column 4. For pub restaurants enter the number of covers in column 4.
4. Divide the energy use of each fuel by the floor area or number of covers to get energy use per unit area (kWh/m2) or energy use per cover (kWh/cover) in column 5.
5. Add the fossil fuel figures together to get a fossil fuel index - the electricity figure can be used directly.
6. Compare the indices with yardsticks for the building type in figure 6.3 to give an energy performance assessment.

Note: this does not take account of the effect of weather on heating energy use (see section 6.4).

Public house

The procedure is:

1. Enter the annual energy use for each fuel into column 1 of figure 6.2.
2. Multiply each fuel by the conversion factor in column 2 to get common units of energy (kWh is used for electricity and now for gas - conversion units are given in Appendix 2).
3. Enter the gross floor area of the building into column 4.
4. Divide the energy use of each fuel by the gross floor area to get energy use per unit area (kWh/m^2) in column 5.
5. Divide the annual energy use per unit area of each fuel by the annual turnover and multiply by 1000 to obtain the annual energy use per m^2 per £1,000 turnover (kWh/m^2/£1,000 turnover) in column 8.
6. Add the fossil fuel figures together to get a fossil fuel index - the electricity figure can be used directly.
7. Compare the indices with yardsticks for the building type in figure 6.3 to give an energy performance assessment.

Note: this does not take account of the effect of weather on heating energy use (see section 6.4).

Figure 6.1 Energy Performance Index Calculation for Restaurants with bar, Fast Food Restaurants and Pub Restaurants

		Column 1 Annual Billed Units			Column 2 kWh* Conversion	Column 3 Annual kWh	Column 4 Gross floor area (m^2) or number of covers - divide by	Column 5 Annual kWh/m^2 or kWh/cover
Gas			kWh	x	1.0			
Oil, type			litres	x				
Other Fossil fuel								
Total of fossil fuel								
Electricity			kWh	x	1.0			

Note * for kWh conversion factors see Appendix 2

There may be exceptional reasons to explain a low or high consumption. For example, a catering establishment may have a low consumption because it has a low turnover, or a high consumption because it has full air conditioning.

Even a building with a low consumption may have opportunities for cost-effective improvement.

The indices show which fuel requires the most attention. The description of typical energy use patterns in section 5 may help to ascertain which use of energy is most likely to offer potential for savings. Section 4 then shows possible energy saving measures for each energy use. The next step is to select and progress suitable measures.

6.3 Overall yardsticks

Overall yardsticks based on carbon dioxide (CO_2) emissions or the cost of energy per m² of floor area can be used to provide a single performance index. These can be used to prepare league tables which compare groups of buildings or to assess buildings which have fuel supply arrangements which do not fit into the yardstick categories. This may occur, for example, in restaurants or public houses with electric heating.

6.4 Refining the performance indices

If there is more information available, you may wish to assess your performance indices further in a number of ways as described in Appendix 1.

- If your building has unusual occupancy, or experiences unusual weather or exposure you may want to know their likely effect.
- You can compare your building performance with the 'Normalised Performance Indicator' used in previous editions of these guides.
- You may wish to take account of the effect of weather when comparing buildings in different parts of the country.

Figure 6.3 Energy Consumption Yardsticks

Performance Assessment

	Low consumption Less than	Medium consumption Between	High consumption Greater than
Restaurant with bar (Yardsticks in kWh/m²)			
Fossil fuels	1100		1250
Electricity	650		730
Fast food restaurant			
Fossil fuels	480		670
Electricity	820		890
Pub restaurant (Yardsticks in kWh/cover)			
Fossil fuels	2700		3500
Electricity	1300		1500
Public House (Yardsticks in kWh/m²/£1,000 turnover)			
Fossil fuels	1.5		3.5
Electricity	0.8		1.8

Figure 6.2 Energy Performance Index Calculation for Public Houses

	Column 1 Annual Billed Units	Column 2 kWh* Conversion		Column 3 Annual kWh	Column 4 Gross floor area (m²) divide by	Column 5 Annual kWh/m²	Column 6 Annual turnover (£) divide by	Column 7 Multiply by	Column 8 Annual kWh/m²/£1000 turnover
Gas		kWh x	1.0					1000	
Oil type		litres x						1000	
Other fossil fuel		x						1000	
Total of fossil fuel									
Electricity		x	1.0					1000	

Note * for kWh conversion factors see Appendix 2

7

A CLOSER LOOK AT ENERGY CONSUMPTION

7.1 Introduction

Often a fuller understanding of energy use in a building may be useful, for example after the initial measures have been undertaken, if there is a problem, if the building has poor performance or if it has unexpected energy bills. This section outlines techniques which you may find useful.

7.2 Monthly energy use

You can ask your supplier for monthly fuel data, or ask the building manager to take monthly meter readings.

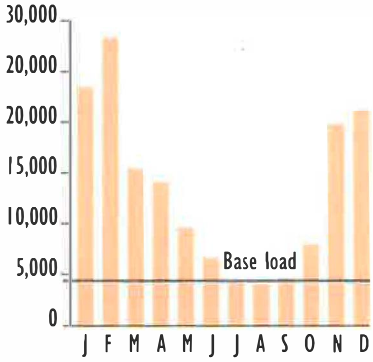
Larger sites have monthly energy bills. By looking at how these vary with the seasons some valuable insights can be obtained. Produce a monthly consumptions bar chart plot for each energy source over a year.

The billing periods should be checked. If they are not regular, some months will appear unrealistically low and others unrealistically high. If this is the case the average daily consumption for each month can be plotted to give more accuracy.

Fossil fuel consumption should reduce in summer, although the degree of reduction will depend on the amount of fossil fuel used for catering and domestic hot water.

Electricity consumption should decrease during summer in a building which is not air conditioned, because of lower lighting loads. In an air conditioned building, peaks in spring and autumn may indicate simultaneous heating and cooling.

Example monthly fossil fuel use



The figure above shows the monthly fossil energy consumption of a fairly efficient building which has a central boiler system for heating and hot water. Fossil fuel also supplies a proportion of the energy used in catering. The summer usage is much lower than winter usage and is at a fairly steady 'base load' level which suggests that the heating is off, though it is useful to confirm this by checking that heating pumps are off, and that pipework used solely for heating is cold.

This graph shows a base load, which helps to identify the hot water load and system losses and catering usage, and the heating load which depends on the weather.

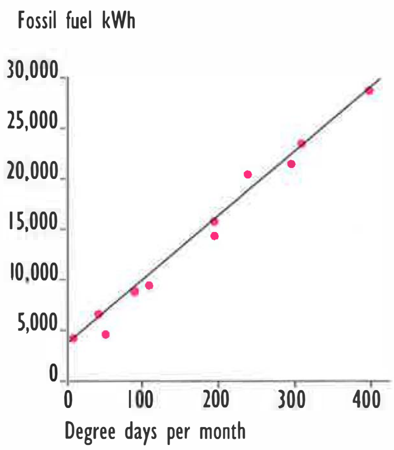
Example monthly electricity use

The figure above shows monthly electricity consumption for a catering establishment without air conditioning. It shows a small increase in the winter months which may be due to increased lighting or some electric heating.

7.3 Relating heating use to weather

A fuel that is mainly used for heating should be used more in colder weather. The coldness of the weather can be expressed by a measure known as degree days. This shows by how much and for how long the outside temperature is below a control temperature (usually 15.5°C). Drawing a graph of fossil fuel consumption against the degree days for each month in the year shows how energy consuption is related to weather. Monthly figures for degree days for different areas of the country are published in the EEO's free bimonthly magazine 'Energy Management' (section 9.4).

Example monthly heating energy use in a well controlled building

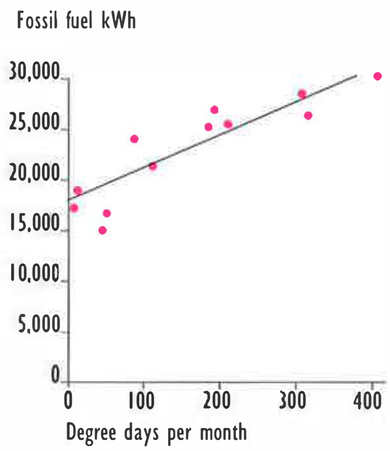


The building represented above has a well controlled heating system, shown by the close fit of the points to the straight line. As the weather becomes colder the energy use goes up proportionally. For this building the energy consumption falls to a small value in summer when the fossil fuel is only being used for catering and to provide hot water. The above plot is more representative of a public house. A restaurant would probably have a higher summer fossil fuel usage

owing to much more substantial catering facilities.

A building with better insulation would have a less steep slope because energy consumption in winter would be lower.

Example monthly heating energy use in a poorly controlled building



The figure above has a large scatter of points indicating a building with poor control. The energy use in the summer months remains high, indicating that there are substantial catering facilities, or that heating is being used unnecessarily or the boiler and hot water systems have high losses which lead to excessive waste.

For further information see:
Fuel Efficiency Booklet 7.
Degree Days

7.4 Adjusting energy use for weather

Once you know how weather conditions affect energy use, it is possible to allow for varying conditions. For example, it is possible to take account of the weather when comparing a building energy performance from year to year. Such comparisons show with greater accuracy the effect of any energy saving measures.

In order to adjust for weather it is necessary to know how much of the fossil energy is used for heating and how much is a steady base load. The base load can be estimated by looking at the monthly consumption of fossil energy as shown in section 7.2 or the graphs of fossil fuel against degree days as shown in section 7.3, and the rest is the energy used for space heating which varies with weather conditions.

CASE STUDIES

This section gives examples of catering establishments where energy saving measures have been implemented.

The use of the Performance Index calculation is also demonstrated, both for assessing how energy efficient a building is, and as a means of evaluating the improvement in energy performance resulting from the implementation of energy saving measures.

Energy cost savings

Gross floor area = 237 m^2	
Overcost of implementing measures	£2,950
Annual energy cost saving	£1,425
Payback period	2.1 years
Reduction in energy use	13%

8.1 The White Horse, Witham, Essex

The White Horse is owned by Greene King and is a semi-detached, two storey public house of brick and stone with a pitched, clay-tiled roof. Public areas are on the ground floor and the manager lives on the first floor. Both cask-conditioned and keg beers, together with a lunchtime hot meal service, are offered.

Greene King decided to refurbish the pub and at the same time incorporate some energy saving measures.

Roof repairs and insulation

Repairs to the roof offered the opportunity to fit insulation. The manager's flat is now warm throughout the winter. The cost of fitting insulation was approximately £1,680. It resulted in an annual energy saving worth about £595, giving a payback period of under 3 years.

Draught stripping/draught lobby

Draught stripping has been applied to existing windows and a new draught lobby has been constructed at the rear of the building. These measures have provided immediate improvement in comfort to customers as well as an annual energy saving of about £175.

Space heating and hot water

A condensing boiler was installed to serve the space heating requirements of both the public and private areas of the White Horse. The over-cost of the condensing boiler compared to a conventional boiler was £290, saving £130/year and leading to a payback period of just over 2 years.

All hot water to the premises is supplied by a separate direct gas-fired water heater, which has a small storage capacity, thereby reducing standing losses, but producing hot water on demand.

Space heating controls

The public and private areas are controlled as two separate zones allowing for different heating requirements and all radiators were fitted with thermostatic radiator valves.

Low energy lighting

Low voltage tungsten halogen lamps were installed in the bar servery and compact fluorescent lamps have been fitted in the toilets.

Cellar improvements

Repairs to cellar doors have improved temperature control in the cellar. This has allowed better control of beer temperature and ensures the refrigeration equipment does not run unnecessarily.

Ventilation improvement

A number of electrostatic air filters were installed to clean and recycle air within the public areas. This overcomes the problem of energy wastage associated with introducing large volumes of cold air and extracting warm air using conventional extract fans.

For further information see:

EEO Good Practice Case Study 57 - The White Horse, Witham, Essex.

8.2 The Bull, Wheathampstead

The Bull is owned and operated by Whitbread. It is one of over 100 establishments whose energy consumption is monitored by the Utilities Manager at the Whitbread Technical Centre. Energy consumptions are reviewed annually and prior to any proposed refurbishments. Energy efficiency considerations also play a part in the purchasing policy for kitchen equipment and refurbishment strategies.

The Bull is a fairly typical "Beefeater" pub/restaurant. It has two storeys and is single glazed with a pitched slate roof. The ground floor of the building houses a 140-seat restaurant and associated kitchens, and a pub with darts area. The first floor houses staff accommodation. The restaurant is open all 365 days of the year, with staff starting work at 9.30 am and working, in shifts, through to 1 am. The restaurant was extended and the whole building refurbished in 1993.

Lighting

Lighting was improved as part of the refurbishment. The Utilities Manager was keen to use more efficient compact fluorescent lamps (CFLs) to improve the energy performance of the lighting.

"Afterwards the interior designer was very pleased with the result, and couldn't argue with the low energy consumption of the CFLs which is a quarter of tungsten bulbs", says the Utilities Manager

Around 60% of lamps are now compact fluorescent. A further 10% are low voltage tungsten halogen spotlights where particular features need to be highlighted.

"CFLs now light most of the interior and have improved its appearance. We have monitored their useful life in other establishments and they are reaching around 8,000 hours. Having to replace them much less frequently than tungsten lamps also gives a maintenance saving as they last around 8 times longer," says the Utilities Manager.

Staff are happy with the new lighting and feel it is in keeping with the ambience of the pub and restaurant. Turnover has risen significantly since the refurbishment due to both extra seating capacity and the improved ambience.

Heating and hot water

The accommodation areas have their own local boilers. This reduces the length of pipe runs and thus the associated heat losses. The boilers were sized to match the heating loads (which maximises efficiency). Each one has its own controller.

Whitbread took the opportunity to install a new efficient gas boiler. The heating circuit was split into three separately controlled zones: one for the bar area and two for different parts of the restaurant.

These measures improved the efficiency of the heating system and enhanced customer comfort in public areas. Operation as a multi-zone system is more efficient than a single zone, as the zones can be heated to different temperatures at different times. If one zone requires heat while another does not, heat will only be supplied to the zone that needs it.

Hot water for the whole building is provided by a direct-fired storage water heater which is separate from the heating systems and controlled by a time clock. The separate water heater is better suited to satisfying the high but intermittent hot water loads generated by the pub, restaurant and accommodation. Separate water heating plant usually gives much higher year-round efficiencies than using the main boiler just to provide water heating in the summer.

Catering

In the kitchen the head chef is keen on good energy housekeeping and insists that equipment is not used wastefully. For example, extract ventilation fans are not used during preparation times but only when meals are being cooked, and gas rings are not left on unnecessarily.

Energy performance

	1992/3	1993/4
Number of covers	86	140
Electricity consumption (kWh)	174,660	210,040
Electricity performance index (kWh/cover/yr)	2,031	1,500
Electricity performance assessment	High consumption	Medium consumption
Gas consumption (kWh)	400,000	378,000
Fossil fuel performance index (kWh/cover/yr)	4,651	2,700
Fossil fuel performance assessment	High consumption	Low consumption

8.3 Catering at the Royal College of Surgeons

The Royal College of Surgeons was formed from a Royal Charter in 1800 and is one of the world's most prestigious educational centres for surgeons, dental surgeons and anaesthetists. Alongside the general catering needs of the 200 staff and up to 60 visiting students, the college regularly holds functions and banquets for up to 350 people. Producing banquets to the highest standard whilst still providing day to day food requires a high degree of flexibility.

The college has a good record on energy efficiency and won a British Gas Regional Gas Energy Management (GEM) award in 1992 for its new heating installation which included combined heat and power (CHP).

The restaurant in the basement is open every day of the year for breakfast and evening meal, and for lunch five days per week. The kitchen and restaurant were refurbished in 1992 as part of an ongoing programme of upgrading facilities. Custom has increased as a result of a brand new servery and the wider menu that can be offered using the new catering equipment. The high quality bulk cooking that can be achieved is essential to meet the needs of the large banquets and receptions held in the private dining halls of the college.

British Gas designed the kitchens and incorporated a number of energy efficient features.

- A highly insulated conveyor dishwasher was installed with a capacity for up to 280 racks per hour. This recycles rinse water which reduces water and energy consumption in the machine. An electronic sensor shuts down the rinse water when there is no basket in the rinse section of the machine. A heat exchanger also recovers heat from the waste water before it passes to drain.

- Three gas fired combination ovens (which can be used for cook chill or conventional cooking) provide steam heating, convection heating or both together. These can roast, braise, fast steam and bake with two levels of humidification for different varieties of food. They allow faster cooking in bulk which is inherently energy efficient whilst still maintaining food quality. Owing to high levels of insulation, the outer casing passes all heat 'touchability' standards. Fan and heaters switch off automatically when the door is opened.

- A gas fired Bartlett DART pressure cooker allows large quantities of food to be cooked very rapidly. For example, it takes only 20 minutes to cook around 40 portions of potatoes with no time spent waiting for pans of water to come to the boil. The reduced cooking times and the dual pressure settings make this a flexible and energy efficient method of cooking compared to conventional boiling pans.

- Two gas fired salamander grills heat up quickly and can therefore be turned off between cooking portions, thus saving energy. Only one grill is used on days when demand is low.

- A large brat pan for bulk shallow frying or for cooking soups etc helps avoid the use of a lot of smaller open pans on a range which would be less efficient.

- The ventilation hood over the main cooking range incorporates a delay timer with a maximum of one hour's operation. This switches the ventilation fans off after the set time which avoids the common practice of leaving them on all day.

The kitchen also includes a traditional range of open gas rings and covered hot plates, hot cupboards, fryers, fridges and freezers.

The college recognises that the key to energy efficiency in the kitchens is a good catering manager. The catering manager ensures that the catering contractors and their chefs practise good housekeeping, such as ensuring that equipment is not left running unnecessarily.

The college management are confident that they have saved energy in the kitchens, but they are considering installing sub meters to monitor the energy consumption there in order to keep an ongoing check on costs.

"I am very pleased with the savings and the improved menus we can now offer", says the catering manager.

9

ADVICE AND HELP

9.1 The Energy Efficiency Office

The Energy Efficiency Office (EEO) is part of the Department of the Environment.

The EEO currently aims to achieve environmental and economic benefits by promoting cost effective energy efficiency measures in the industrial, commercial, domestic and public sectors of the economy by:

- Raising awareness
- Identifying and overcoming barriers to action
- Providing financial incentives where appropriate
- Regulation where necessary
- Providing technical advice.

9.2 Best Practice Programme

The EEO's Best Practice programme gathers and disseminates authoritative information on cost effective energy saving measures. The Best Practice programme for buildings is managed on behalf of the EEO by the Building Research Energy Conservation Support Unit (BRECSU) and for industry by the Energy Technology Support Unit (ETSU).

A range of publications is available under the Best Practice programme, normally free of charge. Relevant titles for catering establishments are given below.

Good Practice Guides give advice on how to implement energy saving measures. Relevant titles are as follows:

15 Energy efficient refurbishment of public houses.
71 Selecting air conditioning systems
84 Managing and motivating staff to save energy.

General Information Leaflets and Reports also give advice on how to implement energy saving measures. Relevant General Information Leaflets are:

1 The success of condensing boilers in non-domestic buildings. A user study
3 Condensing boilers - applied to public houses and catering establishments

Information on energy management is contained in these General Information Reports:

12 Organisational aspects of energy management
13 Reviewing energy management
14 Energy management of buildings including a review of some case studies.

Good Practice Case Studies provide examples of proven techniques which are already enabling the better energy users to be more energy efficient. Good Practice Case Study 27 provides an example of compressor motor controllers on refrigeration plant and Case Studies 44 to 58 give examples of a wide range of public houses.

Fuel Efficiency Booklets are working manuals which provide detailed technical guidance on specific areas of energy use in buildings and industry. Relevant booklets are:

1 Energy audits for buildings
7 Degree days
8 The economic thickness of insulation for hot pipes
9 Economic use of electricity in buildings
10 Controls and energy savings
12 Energy management and good lighting practices.

In addition, a wide range of events is organised to promote the results of the Best Practice programme. These include seminars, workshops and site visits and are targeted at different sectors and professionals.

Details of publications and events can be obtained from:

BRECSU (for buildings)
Building Research Establishment
Garston
Watford WD2 7JR
Tel: 0923 664258
Fax: 0923 664097

ETSU (for industrial sectors)
Harwell
Didcot
Oxon OX11 ORA
Tel: 0235 436747
Fax: 0235 432923.

9.3 Other Publications Available From BRECSU

Energy Efficient Lighting in Buildings (1992). A THERMIE Maxibrochure.

9.4 Free Publications From the EEO

The Introduction to Energy Efficiency series. There are 13 Guides in this series, of which this is one:

Catering establishments
Entertainment buildings
Factories and warehouses
Further and higher education
Health care buildings
Hotels
Museums, galleries, libraries and churches
Offices
Post Offices, banks, building societies and agencies
Prisons, emergency buildings and courts
Schools
Shops and stores
Sports and recreation centres

Choosing an Energy Efficiency Consultant (EMAS 2)

Practical Energy Saving Guide for Smaller Businesses (ACBE 1)

The above are all available from:
Department of the Environment
Blackhorse Rd
London SE99 6TT
Tel: 081 691 9000

The 'Energy Management' journal. Published bi-monthly and available from the EEO.
Tel: 071 276 6200.

9.5 Other EEO Programmes

Making a Corporate Commitment Campaign

The 'Making a Corporate Commitment' campaign seeks board level commitment to energy efficiency. It encourages directors to sign a Declaration of Commitment to responsible energy management, prepare a business plan for energy efficiency and ensure that it becomes an item that is considered regularly by their main board.

Publications:

Chairman's Checklist
Executive Action Plan
Energy, Environment and Profits - Six case studies on corporate commitment to energy efficiency.

Further information is available from the Campaign Offices on 071 276 4613.

Energy Management Assistance Scheme

The Energy Management Assistance Scheme may provide support for small and medium sized businesses (up to 500 employees) to employ an energy consultant. This aims to upgrade the expertise in energy efficiency among smaller companies, and tackle the capital priority barrier through financial support.

Further information can be obtained on 071 276 3787.

9.6 Sources of Free Advice and Information

Regional Energy Efficiency Officers

11 Regional Energy Efficiency Officers (REEOs) around the UK can provide copies of all the EEO's literature and give specific advice on:

- opportunities for better energy efficiency in your organisation
- technologies and management techniques you should be thinking about
- appropriate sources of specialist advice and assistance in the private sector
- EEO programmes
- regional energy managers' groups.

REEO Northern Region
Wellbar House
Gallowgate
Newcastle Upon Tyne NE1 4TD
Tel: 091 201 3343

REEO Yorkshire and Humberside
City House
New Station Street
Leeds LS1 4JD
Tel: 0532 836 376

REEO North West
Sunley Tower
Piccadilly Plaza
Manchester M1 4BA
Tel: 061 838 5335

REEO East Midlands
Cranbrook House
Cranbrook Street
Nottingham
Nottinghamshire NG1 1EY
Tel: 0602 352 292

REEO West Midlands
Five Ways Tower
Frederick Road
Birmingham B15 1SJ
Tel: 021 626 2222

REEO Eastern
Heron House
49-53 Goldington Road
Bedford MK40 3LL
Tel: 0234 276 194

REEO South West
Tollgate House
Houlton Street
Bristol BS2 9DJ
Tel: 0272 878 665

REEO South East
Charles House
Room 565
375 Kensington High St
London W14 8QH
Tel: 071 605 9160

REEO Scotland
New St Andrews House
Edinburgh
Scotland EH1 3TG
Tel: 031 244 4662

REEO Wales
Cathays Park
Cardiff
Wales CF1 1NQ
Tel: 0222 823 126

REEO Northern Ireland
Dept of Economic Development
Netherleigh House
Massey Avenue
Belfast
N Ireland BT4 2JT
Tel: 0232 529900.

9.7 Other Programmes

Energy Design Advice Scheme

The Energy Design Advice Scheme is a Department of Trade and Industry discretionary initiative aimed at improving the energy and environmental performance of the building stock by making low energy building design expertise more accessible for the energy efficient design and refurbishment of buildings. The scheme offers support, via a number of Regional Centres, to design teams or clients in the energy aspects of design of new buildings or refurbishment projects over 500m² gross area.

Further information can be obtained from the following Regional Centres:

For Scotland
Tel: 031 228 4414

For South East England
Tel: 071 916 3891

For Northern England
Tel: 0742 721 140

For Northern Ireland
Tel: 0232 364 090.

EU Programmes

There are several EU programmes aimed at demonstrating energy efficiency measures and encouraging energy efficiency R&D. Details change periodically. For further information contact BRECSU for buildings and ETSU for industry.

9.8 Other Publications

Chartered Institution of Building Services Engineers (CIBSE):

> CIBSE Applications Manual, AM 5:1991, Energy Audits and Surveys
>
> CIBSE Applications Manual, AM 6:1991, Contract Energy Management
>
> CIBSE Applications Manual, AM3, Condensing Boilers
>
> CIBSE Applications Manual, AM8, Private and Standby Generation of Electricity
>
> CIBSE Code for Interior Lighting (1984)
>
> CIBSE Lighting Guide 3(LG3)(1989). Areas for Visual Display Terminals.

Available from:

CIBSE, 222 Balham High Rd,
Balham,
London SW12 9BS.
Tel: 081 675 5211
Fax: 081 675 5449.

Heating and Ventilating Contractors Association (HVCA):

> Standard Specification for Maintenance of Building Services. Volumes 1 - 5. 1990 - 1992.

Available from:

HVCA Publications, Old Mansion House, Earmont Bridge, Cumbria, CA10 2BX
Tel: 0768 64771.

9.9 Other Useful Addresses

Energy Systems Trade Association Ltd (ESTA)
PO Box 16, Stroud, Gloucestershire
GL6 9YB
Tel: 0453 886776
Fax: 0453 885226

Major Energy Users' Council
10 Audley Road
London W5 3ET
Tel: 081 997 2561/3854
Fax: 081 566 7073.

APPENDIX 1

Development of Building Performance Indices (PI)

Introduction

This section outlines how to calculate environmental and cost indices for the energy used in your building. It describes the effect of weather and exposure on the performance of a building, with a method to allow for these factors if required.

Figure A1.1 CO_2 Performance Index Calculation

	Column 1 Annual energy use kWh/m² or kWh/cover or kWh/m²/ £1,000 turnover	Column 2 CO_2 conversion* factors kg/kWh	Column 3 Annual CO_2 emissions kg/m² or kg/cover or kg/m²/ £1,000 turnover
Gas		x 0.20	
Oil		x 0.29	
Coal		x 0.32	
Electricity		x 0.70	
CO_2 emissions / m² **CO_2 emissions / cover** **CO_2 emissions / m²/ £1,000 turnover**			

*typical 1993 emission factors

Figure A1.2 Cost Performance Index Calculation

	Column 1 Annual energy use kWh/m² or kWh/cover or kWh/m²/ £1,000 turnover	Column 2 *Cost conversion factors £/kWh	Column 3 Annual cost £/m² or £/cover or £/m²/ £1,000 turnover
Gas		x 0.014	
Oil		x 0.012	
Coal		x 0.009	
Electricity		x 0.071	
Energy cost / m² **Energy cost / cover** **Energy cost / m²/ £1,000 turnover**			

*typical 1992 fuel prices

Adjustments of the PI for these factors produces a 'Normalised Performance Index' (NPI) which is compatible with earlier versions of this guide. For many purposes, the effect of these factors on performance indices is small enough to be ignored.

Overall performance indices

Overall performance indices provide a single measure of building performance, and can be expressed in terms of carbon dioxide (CO_2) emissions or energy cost. Overall energy indices are useful for comparing a stock of buildings. However, separate fossil fuel and electricity performance indices are more useful to assist in deciding a course of action.

To calculate overall performance indices you need the annual energy use indices as obtained in figure 6.1 or figure 6.2 and conversion factors for each of the fuels - some of which are given in figures A1.1 and A1.2. The calculation procedure is to enter the energy use figures in Column 1, and multiply by the relevant conversion factors in column 2 to get either the CO_2 emissions or cost in column 3.

The conversion factors shown are broadly representative of the current fuels used in catering establishments and can be used if a consistent set of factors is required. CO_2 factors, particularly for electricity may vary from this data. Cost factors will also vary over time and as a function of use. Energy unit costs at larger premises tend to be cheaper than for smaller supplies. You may wish to use your own costs from your fuel bills instead of those given here.

Overall yardsticks for CO_2 emissions or energy costs can also be calculated, by inserting yardstick energy consumptions (given in figure 6.3) into column 1. These can be compared with the actual index for your building to give an overall assessment. CO_2 and cost yardsticks calculated on the basis that the fossil fuel is gas are presented in figure A1.3.

Effect of weather on energy use

Weather changes from year to year for a given site cause variations in heating energy use of typically ±5% from the average values or ±10% in more extreme years.

Weather differences across the country cause variation in heating requirements of typically ±10% from average values and ±20% in more extreme areas.

The effect on electricity use will be small unless electricity is used for space heating, or in air conditioned buildings where the cooling energy will be higher during a warm summer.

The effect on catering establishments with very little space heating, such as many fast food restaurants, will be small.

Exposure

If a building is very exposed (on an exposed hill for example), heating energy increases by 5-10% and likewise a completely protected building may use 5-10% less. In many cases steps will have been taken on exposed buildings to improve draught sealing which will offset the increase. Electricity use is largely unaffected except in electrically heated buildings.

Normalised performance indices

It is possible to adjust (normalise) performance indices for weather and exposure, but care is needed as incorrectly applied adjustments, or adjustments that are too simplistic, may introduce larger errors than the typical variations discussed above.

Note also that while a normalised performance index is a better

measure of a building's efficiency than an unnormalised index, the latter shows the building's actual performance. So a building with a low normalised performance index, but a high performance index before adjustment, is efficient, but since it is still a high user of energy, it may well offer good opportunities for cost effective energy saving.

Figure A1.4 can be used to obtain performance indices which are normalised to standard conditions of weather and exposure. This is useful if:

- You require normalised performance indices for compatibility with previous work
- Any of the factors cause significant errors (see above sub sections to evaluate this).

A normalised performance index based on overall CO_2 emissions or cost is obtained by using figure A1.1 or A1.2, and inserting the normalised index for each fuel into column 1. If more than one fuel is used for heating, calculate a separate normalised performance index for each fuel first and then use this procedure.

Performance indices - summary

- Simple performance indices are for initial energy assessments. Separate performance indices are calculated, one for fossil fuels and one for electricity use, and no adjustments are made.
- Overall performance indices, based on carbon dioxide (CO_2) or cost, are normally used when a number of buildings are to be compared. Also, you may want to know the cost or the CO_2 performance for a single catering establishment.
- Normalised performance indices are used when more sensitive comparisons are required and the effect of weather and exposure become significant. But if you choose to normalise, be aware of introducing errors.

Figure A1.3 Carbon dioxide and cost yardsticks

CO_2 Performance Assessment

Overall CO_2 yardstick

	Low Emissions (Less than)	Medium Emissions (Between)	High Emissions (Greater than)
*Yardsticks in kg CO_2 /m²			
Restaurant with bar	675		760
Fast food restaurant	670		755
*Yardsticks in kg CO_2 /cover			
Pub restaurant	1450		1750
*Yardsticks in kg CO_2 /m² /£1,000 turnover			
Public House	0.9		2.0

Cost Performance Assessment

Overall cost yardstick

	Low Cost (Less than)	Medium Cost (Between)	High Cost (Greater than)
*Yardsticks in £/m²			
Restaurant with bar	60		70
Fast food restaurant	65		75
*Yardsticks in £/cover			
Pub restaurant	130		155
*Yardsticks in £ /m² /£1,000 turnover			
Public House	0.08		0.18

*CO_2 and cost yardsticks are based on factors given in figures A1.1 & A1.2

Figure A1.4 Normalised Performance Indices calculation

	Fossil fuel Gas	Oil	Other		Total of Fossil Fuels	Electricity
Total energy consumption (kWh)				(A)		
Space heating energy (kWh)				*(B)		
Non space heating energy (kWh)				A-B = (C)		
Find the degree days for the energy data year				*(D)		
Weather correction factor = 2462 ÷ D =				(E)		
Obtain the exposure factor from below				*(F)		
Annual heating energy use for standard conditions				BxExF = (G)		
Normalised energy use = C + G =				kWh (H)		

For restaurants with bar, fast food restaurants, pub restaurants

Find gross floor area or number of covers	no of covers or m² (J)		
Find the Normalised Performance Indices = (H÷J)	kWh/m² or kWh/cover (K)		

For public houses

Find gross floor area	m² (L)		
Find turnover	£ (M)		
Find the Normalised Performance Indices = (H ÷ L ÷ M) x 1000=	kWh/m²/£1,000 turnover (N)		

* Notes:
(B) Estimation of weather-dependent heating energy use is discussed in section 7.
(D) For degree day information, see Fuel Efficiency Booklet 7 - Degree Days
Monthly degree day figures are published in 'Energy Management' (see section 9.4)
(F) Exposure factors from figure A1.5.

Figure A1.5 Exposure Factors

	Factor
Sheltered. The building is in a built-up area with other buildings of similar or greater height surrounding it. This would apply to most city centre locations.	1.1
Normal. The building is on level ground in urban or rural surroundings. It would be usual to have some trees or adjacent buildings.	1.0
Exposed. Coastal and hilly sites with little or no adjacent screening.	0.9

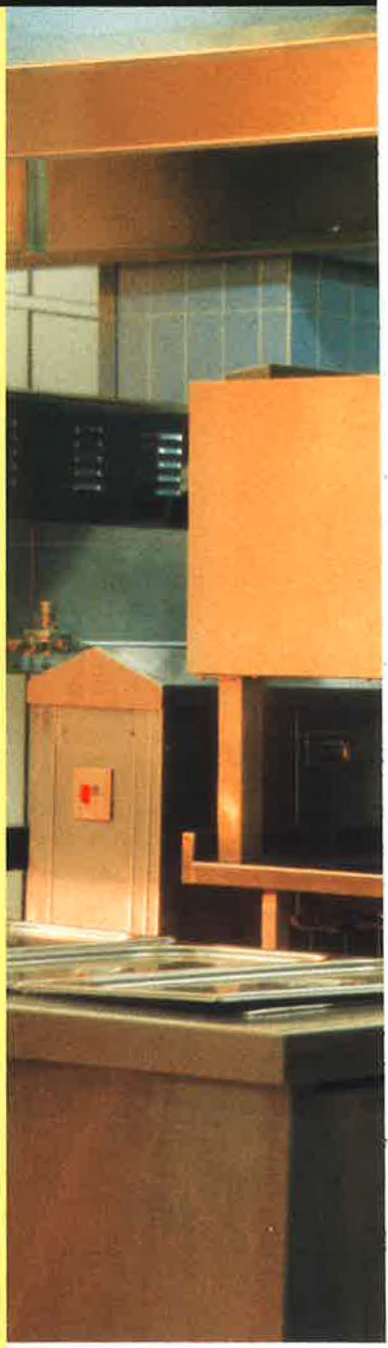
APPENDIX 2

Energy Conversion Factors

The unit of energy used in this guide is the kilowatt - hour (kWh). One kilowatt - hour is consumed by a typical one bar electrical fire in one hour. For fuels which are metered in other units, multiply the metered value by the relevant conversion factor from the following table to obtain the value in kWh.

Figure A2.1 Conversion to kWh

	kWh conversion
Light Fuel Oil	11.2 kWh/litre
Medium Fuel Oil	11.3 kWh/litre
Heavy Fuel Oil	11.4 kWh/litre
Gas Oil (35 second)	10.8 kWh/litre
Kerosene - burning oil (22 second)	10.4 kWh/litre
Electricity	[Metered directly in kWh]
Natural gas	29.31 kWh/therm
Liquid Petroleum Gas (LPG) (Propane)	6.96 kWh/litre
Coal (washed shingles)	7,900 kWh/tonne
Coal (washed smalls)	7,800 kWh/tonne



BEST PRACTICE PROGRAMME

Energy Efficiency Office

DEPARTMENT OF THE ENVIRONMENT

Published by the Department of the Environment. Printed in Great Britain
on environmentally friendly paper. March 1994.
93EP713.